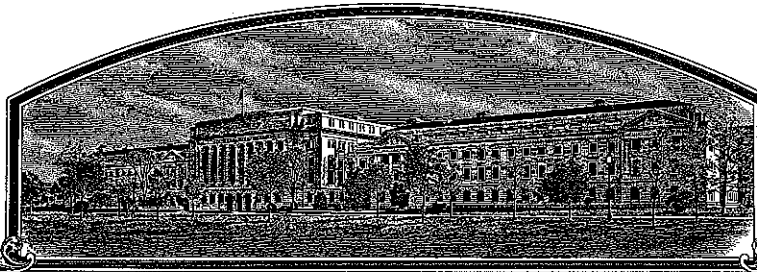


No.

200400199



THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

Pioneer Hi-Bred International, Inc.

Whereas, THERE HAS BEEN PRESENTED TO THE

Secretary of Agriculture

AN APPLICATION REQUESTING A CERTIFICATE OF PROTECTION FOR AN ALLEGED DISTINCT VARIETY OF SEXUALLY REPRODUCED, OR TUBER PROPAGATED PLANT, THE NAME AND DESCRIPTION OF WHICH ARE CONTAINED IN THE APPLICATION AND EXHIBITS, A COPY OF WHICH IS HEREUNTO ANNEXED AND MADE A PART HEREOF, AND THE VARIOUS REQUIREMENTS OF LAW IN SUCH CASES MADE AND PROVIDED HAVE BEEN COMPLIED WITH, AND THE TITLE THERETO IS, FROM THE RECORDS OF THE PLANT VARIETY PROTECTION OFFICE, IN THE APPLICANT(S) INDICATED IN THE SAID COPY, AND WHEREAS, UPON DUE EXAMINATION MADE, THE SAID APPLICANT(S) IS (ARE) ADJUDGED TO BE ENTITLED TO A CERTIFICATE OF PLANT VARIETY PROTECTION UNDER THE LAW.

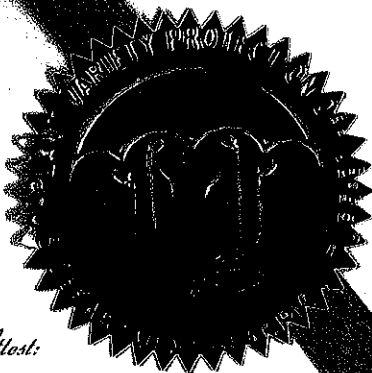
NOW, THEREFORE, THIS CERTIFICATE OF PLANT VARIETY PROTECTION IS TO GRANT UNTO THE SAID APPLICANT(S) AND THE SUCCESSORS, HEIRS OR ASSIGNS OF THE SAID APPLICANT(S) FOR THE TERM OF TWENTY YEARS FROM THE DATE OF THIS GRANT, SUBJECT TO THE PAYMENT OF THE REQUIRED FEES AND PERIODIC REPLENISHMENT OF VIABLE BASIC SEED OF THE VARIETY IN A PUBLIC REPOSITORY AS PROVIDED BY LAW, THE RIGHT TO EXCLUDE OTHERS FROM SELLING THE VARIETY, OR OFFERING IT FOR SALE, OR REPRODUCING IT, OR IMPORTING IT, OR EXPORTING IT, OR CONDITIONING IT FOR PROPAGATION, OR STOCKING IT FOR ANY OF THE FOREGOING PURPOSES, OR USING IT IN PRODUCING A HYBRID OR DIFFERENT VARIETY THEREFROM, TO THE EXTENT PROVIDED BY THE PLANT VARIETY PROTECTION ACT. (84 STAT. 1542, AS AMENDED, 7 U.S.C. 2321 ET SEQ.)

CORN, FIELD

'PHAKC'

In Testimony Whereof, I have hereunto set my hand and caused the seal of the Plant Variety Protection Office to be affixed at the City of Washington, D.C. this third day of November, in the year two thousand and six.

Attest:



[Signature]

Commissioner
Plant Variety Protection Office
Agricultural Marketing Service

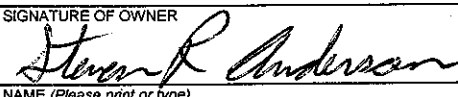
[Signature]
Secretary of Agriculture

U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE
SCIENCE AND TECHNOLOGY - PLANT VARIETY PROTECTION OFFICE

APPLICATION FOR PLANT VARIETY PROTECTION CERTIFICATE
(Instructions and information collection burden statement on reverse)

The following statements are made in accordance with the Privacy Act of 1974 (5 U.S.C. 552a) and the Paperwork Reduction Act (PRA) of 1995.

Application is required in order to determine if a plant variety protection certificate is to be issued (7 U.S.C. 2421). Information is held confidential until certificate is issued (7 U.S.C. 2426).

1. NAME OF OWNER Pioneer Hi-Bred International, Inc.		2. TEMPORARY DESIGNATION OR EXPERIMENTAL NAME	3. VARIETY NAME PHAKC
4. ADDRESS (Street and No., or R.F.D. No., City, State, and ZIP Code, and Country) 7301 NW 62nd Avenue Johnston, IA 50131-0085		5. TELEPHONE (include area code) 515/270-4051	FOR OFFICIAL USE ONLY PVPO NUMBER 2004 00 199
		6. FAX (include area code) 515/253-2125	
7. IF THE OWNER NAMED IS NOT A "PERSON", GIVE FORM OF ORGANIZATION (corporation, partnership, association, etc.) Corporation	8. IF INCORPORATED, GIVE STATE OF INCORPORATION IOWA	9. DATE OF INCORPORATION March 5, 1999	
10. NAME AND ADDRESS OF OWNER REPRESENTATIVE(S) TO SERVE IN THIS APPLICATION. (First person listed will receive all papers) Steven R. Anderson Research and Product Development P.O. Box 85 Johnston, IA 50131-0085		FILING AND EXAMINATION FEES: \$ 3652.00 DATE 5/4/04 CERTIFICATION FEE: \$ 768.00 DATE 10/5/06	
11. TELEPHONE (Include area code) 515/270-4051	12. FAX (Include area code) 515/253-2125	13. E-MAIL steven.anderson@pioneer.com	
14. CROP KIND (Common Name) CORN	16. FAMILY NAME (Botanical) Gramineae	18. DOES THE VARIETY CONTAIN ANY TRANSGENES? (OPTIONAL) <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO IF SO, PLEASE GIVE THE ASSIGNED USDA-APHIS REFERENCE NUMBER FOR THE APPROVED PETITION TO DEREGULATE THE GENETICALLY MODIFIED PLANT FOR COMMERCIALIZATION.	
15. GENUS AND SPECIES NAME OF CROP Zea Mays	17. IS THE VARIETY A FIRST GENERATION HYBRID? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		
19. CHECK APPROPRIATE BOX FOR EACH ATTACHMENT SUBMITTED (Follow instructions on reverse) a. <input checked="" type="checkbox"/> Exhibit A. Origin and Breeding History of the Variety b. <input checked="" type="checkbox"/> Exhibit B. Statement of Distinctness c. <input checked="" type="checkbox"/> Exhibit C. Objective Description of Variety d. <input type="checkbox"/> Exhibit D. Additional Description of the Variety (Optional) e. <input checked="" type="checkbox"/> Exhibit E. Statement of the Basis of the Owner's Ownership f. <input checked="" type="checkbox"/> Voucher Sample (2,500 viable untreated seeds or, for tuber propagated varieties, verification that tissue culture will be deposited and maintained in an approved public repository) g. <input checked="" type="checkbox"/> Filing and Examination Fee (\$3,652), made payable to "Treasurer of the United States" (Mail to the Plant Variety Protection Office)		20. DOES THE OWNER SPECIFY THAT SEED OF THIS VARIETY BE SOLD AS A CLASS OF CERTIFIED SEED? (See Section 83(a) of the Plant Variety Protection Act) <input type="checkbox"/> YES (If "yes", answer items 21 and 22 below) <input checked="" type="checkbox"/> NO (If "no", go to item 23) 21. DOES THE OWNER SPECIFY THAT SEED OF THIS VARIETY BE LIMITED AS TO NUMBER OF CLASSES? <input type="checkbox"/> YES <input type="checkbox"/> NO IF YES, WHICH CLASSES? <input type="checkbox"/> FOUNDATION <input type="checkbox"/> REGISTERED <input type="checkbox"/> CERTIFIED 22. DOES THE OWNER SPECIFY THAT SEED OF THIS VARIETY BE LIMITED AS TO NUMBER OF GENERATIONS? <input type="checkbox"/> YES <input type="checkbox"/> NO IF YES, SPECIFY THE NUMBER 1,2,3, etc. FOR EACH CLASS. <input type="checkbox"/> FOUNDATION <input type="checkbox"/> REGISTERED <input type="checkbox"/> CERTIFIED (If additional explanation is necessary, please use the space indicated on the reverse.)	
23. HAS THE VARIETY (INCLUDING ANY HARVESTED MATERIAL) OR A HYBRID PRODUCED FROM THIS VARIETY BEEN SOLD, DISPOSED OF, TRANSFERRED, OR USED IN THE U. S. OR OTHER COUNTRIES? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO IF YES, YOU MUST PROVIDE THE DATE OF FIRST SALE, DISPOSITION, TRANSFER, OR USE FOR EACH COUNTRY AND THE CIRCUMSTANCES. (Please use space indicated on reverse.)		24. IS THE VARIETY OR ANY COMPONENT OF THE VARIETY PROTECTED BY INTELLECTUAL PROPERTY RIGHT (PLANT BREEDER'S RIGHT OR PATENT)? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO IF YES, PLEASE GIVE COUNTRY, DATE OF FILING OR ISSUANCE AND ASSIGNED REFERENCE NUMBER. (Please use space indicated on reverse.)	
25. The owners declare that a viable sample of basic seed of the variety has been furnished with application and will be replenished upon request in accordance with such regulations as may be applicable, or for a tuber propagated variety a tissue culture will be deposited in a public repository and maintained for the duration of the certificate. The undersigned owner(s) is(are) the owner of this sexually reproduced or tuber propagated plant variety, and believe(s) that the variety is new, distinct, uniform, and stable as required in Section 42, and is entitled to protection under the provisions of Section 42 of the Plant Variety Protection Act. Owner(s) is (are) informed that false representation herein can jeopardize protection and result in penalties.			
SIGNATURE OF OWNER		SIGNATURE OF OWNER 	
NAME (Please print or type)		NAME (Please print or type) Steven R. Anderson	
CAPACITY OR TITLE	DATE	CAPACITY OR TITLE	DATE
		Research Scientist	5-3-2004

GENERAL: To be effectively filed with the Plant Variety Protection Office (PVPO), ALL of the following items must be received in the PVPO: (1) Completed application form signed by the owner; (2) completed exhibits A, B, C, E; (3) for a seed reproduced variety at least 2,500 viable untreated seeds, for a hybrid variety at least 2,500 untreated seeds of each line necessary to reproduce the variety, or for tuber reproduced varieties verification that a viable (*in the sense that it will reproduce an entire plant*) tissue culture will be deposited and maintained in an approved public repository; (4) check drawn on a U.S. bank for \$3,652 (\$432 filing fee and \$3,220 examination fee), payable to "Treasurer of the United States" (See Section 97.6 of the Regulations and Rules of Practice.) Partial applications will be held in the PVPO for not more than 90 days, then returned to the applicant as unfilled. Mail application and other requirements to Plant Variety Protection Office, AMS, USDA, Room 401, NAL Building, 10301 Baltimore Avenue, Beltsville, MD 20705-2351. Retain one copy for your files. All items on the face of the application are self explanatory unless noted below. Corrections on the application form and exhibits must be initialed and dated. **DO NOT** use masking materials to make corrections. If a certificate is allowed, you will be requested to send a check payable to "Treasurer of the United States" in the amount of \$432 for issuance of the certificate. Certificates will be issued to owner, not licensee or agent.

Plant Variety Protection Office

Telephone: (301) 504-5518

FAX: (301) 504-5291

Homepage: <http://www.ams.usda.gov/science/pvpo/pvp.htm>

To avoid conflict with other variety names in use, the applicant must check the appropriate recognized authority and provide evidence that name has been cleared by the appropriate recognized authority before the Certificate of Protection is issued. For example, for agricultural and vegetable crops, contact: Seed Branch, AMS, USDA, 10301 Baltimore Avenue, Suite 401 NAL Building, Beltsville, MD 20705. Telephone: (301) 504-5682
<http://www.ams.usda.gov/lsg/seed.htm>.

ITEM

- 19a. Give: (1) the genealogy, including public and commercial varieties, lines, or clones used, and the breeding method;
(2) the details of subsequent stages of selection and multiplication;
(3) evidence of uniformity and stability; and
(4) the type and frequency of variants during reproduction and multiplication and state how these variants may be identified
- 19b. Give a summary of the variety's distinctness. Clearly state how this application variety may be distinguished from all other varieties in the same crop. If the new variety is most similar to one variety or a group of related varieties:
- (1) identify these varieties and state all differences objectively;
 - (2) attach statistical data for characters expressed numerically and demonstrate that these are clear differences; and
 - (3) submit, if helpful, seed and plant specimens or photographs (prints) of seed and plant comparisons which clearly indicate distinctness.
- 19c. Exhibit C forms are available from the PVPO Office for most crops; specify crop kind. Fill in Exhibit C (Objective Description of Variety) form as completely as possible to describe your variety.
- 19d. Optional additional characteristics and/or photographs. Describe any additional characteristics that cannot be accurately conveyed in Exhibit C. Use comparative varieties as is necessary to reveal more accurately the characteristics that are difficult to describe, such as plant habit, plant color, disease resistance, etc.
- 19e. Section 52(5) of the Act requires applicants to furnish a statement of the basis of the applicant's ownership. An Exhibit E form is available from the PVPO.
20. If "Yes" is specified (*seed of this variety be sold by variety name only, as a class of certified seed*), the applicant **MAY NOT** reverse this affirmative decision after the variety has been sold and so labeled, the decision published, or the certificate issued. However, if "No" has been specified, the applicant may change the choice. (See Regulations and Rules of Practice, Section 97.103).
23. See Sections 41, 42, and 43 of the Act and Section 97.5 of the regulations for eligibility requirements.
24. See Section 55 of the Act for instructions on claiming the benefit of an earlier filing date.

22. CONTINUED FROM FRONT (Please provide a statement as to the limitation and sequence of generations that may be certified.)

23. CONTINUED FROM FRONT (Please provide the date of first sale, disposition, transfer, or use for each country and the circumstances, if the variety (including any harvested material) or a hybrid produced from this variety has been sold, disposed of, transferred, or used in the U.S. or other countries.)

United States, Nov. 1, 2003

24. CONTINUED FROM FRONT (Please give the country, date of filing or issuance, and assigned reference number, if the variety or any component of the variety is protected by intellectual property right (Plant Breeder's Right or Patent).)

NOTES: It is the responsibility of the applicant/owner to keep the PVPO informed of any changes of address or change of ownership or assignment or owner's representative during the life of the application/certificate. The fees for filing a change of address; owner's representative; ownership or assignment; or any modification of owner's name is specified in Section 97.175 of the regulations. (See Section 101 of the Act, and Sections 97.130, 97.131, 97.175(h) of the Regulations and Rules of Practice.)

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0581-0055. The time required to complete this information collection is estimated to average 1.4 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, sexual orientation, marital or family status, political beliefs, parental status, or protected genetic information. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720-2600 (voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call 202-720-5964 (voice and TDD). USDA is an equal opportunity provider and employer.

Exhibit A. Origin and Breeding History

Pedigree: PH1AD/PH1G7)XA122132X

Pioneer Line PHAKC, *Zea mays L.*, a yellow endosperm corn inbred with some flint characteristics, was developed by Pioneer Hi-Bred International, Inc. from the single cross hybrid PH1AD X PH1G7 using the pedigree method of plant breeding. Varieties PH1AD and PH1G7 are proprietary inbred lines of Pioneer Hi-Bred International, Inc. Variety PH1AD was derived by pedigree selection from the single cross hybrid PHP38 (Certificate No. 9000250) X PHHB4 (Certificate No. 9400093). Variety PH1G7 was derived by pedigree selection from the single cross hybrid PHT11 (Certificate No. 9100101) X PHHB9 (Certificate No. 9300108). Selfing was practiced from the above hybrid for 8 generations using pedigree selection. During line development, crosses were made to inbred testers for the purpose of estimating the line's combining ability. Yield trials were grown at Champaign, IL as well as other Pioneer research locations. After initial testing, additional hybrid combinations have been evaluated and subsequent generations of the line have been grown and hand-pollinated with observations again made for uniformity.

Variety PHAKC has shown uniformity and stability for all traits as described in Exhibit C - "Objective Description of Variety". It has been self-pollinated and ear-rowed 6 generations with careful attention paid to selection criteria and uniformity of plant type to assure genetic homozygosity and phenotypic stability. The line has been increased both by hand and in isolated fields with continued observations for uniformity and stability, and for 3 generations during the final stages of inbred development and seed multiplication. Very high standards for genetic purity have been established morphologically using field observations and electrophoretically using sound lab molecular marker methodology.

No variant traits have been observed or are expected in PHAKC.

The criteria used in the selection of PHAKC were yield, both per se and in hybrid combinations; late season plant health, grain quality, stalk lodging resistance, and kernel size, especially important in production. Other selection criteria include: ability to germinate in adverse conditions; disease and insect resistance; pollen yield and tassel size.

Exhibit A: Developmental history for PHAKC

Season/Year Pedigree Grown	Inbreeding Level of Pedigree Grown
PH1AD	F0
PH1G7	F0
PH1AD/PH1G7 Winter 1995	F1
PH1AD/PH1G7)X Summer 1997	F2
PH1AD/PH1G7)XA1 Summer 1998	F3
PH1AD/PH1G7)XA12 Summer 1999	F4
PH1AD/PH1G7)XA122 Winter 1999	F5
PH1AD/PH1G7)XA1221 Summer 2000	F6
PH1AD/PH1G7)XA12213 Winter 2000	F7
PH1AD/PH1G7)XA122132 Summer 2001	F8
PH1AD/PH1G7)XA122132X	F9 SEED

*PHAKC was selfed and ear-rowed from F3 through F8 generation.

#Uniformity and stability were established from F7 through F9 generation and beyond when seed supplies were increased.

Exhibit B: Novelty Statement

Variety PHAKC mostly resembles Pioneer Hi-Bred International, Inc. proprietary inbred line PH2VK (PVP Certificate No. 9900363). Tables 1A and 1B show two sample t-tests on data collected primarily in Johnston and Dallas Center, IA. The traits collectively show measurable differences between the two varieties.

Exhibit B: Novelty Statement

Variety PHAKC has a greater husk length (24.7 cm vs 22.4 cm) than variety PH2VK (Table 1A, 1B).

Variety PHAKC has a smaller stalk diameter (12.1 mm vs 14.4 mm) than variety PH2VK (Table 1A, 1B).

Variety PHAKC has a lower GLFSPT score (4.1 vs 5.5) than variety PH2VK (Table 2A, 2B).

Definitions:

GLFSPT = Gray Leaf Spot (*Cercospora zeae-maydis*).

- A 1 to 9 visual rating indicating the resistance to Gray Leaf Spot. A higher score indicates a higher resistance.

Exhibit B: Novelty Statement Tables

Table 1A: Data from Johnston and Dallas Center, IA broken out by year and across environments are supporting evidence for differences between PHAKC and PH2VK. Each year varieties were grown in 3 locations that had different environmental conditions. Environments had different planting dates and were in different fields. A two-sample t-test was used to compare differences between means.

DataField	YEAR	VARIETY-1	VARIETY-2	Count-1	Count-2	Mean-1	Mean-2	Mean_Diff	StdDeviation-1	StdDeviation-2	StdError-1	StdError-2	DF_Pooled	t-Value_Pooled	Prob_(2-tail)_Pooled
husk length (cm)	2002	PHAKC	PH2VK	15	15	25.3	22.0	3.3	1.633	1.069	0.422	0.276	28	6.6	0.000
husk length (cm)	2003	PHAKC	PH2VK	15	15	24.1	22.8	1.3	1.280	1.146	0.330	0.296	28	2.9	0.008
stalk diameter (mm)	2002	PHAKC	PH2VK	15	15	13.1	15.5	-2.4	1.807	0.990	0.467	0.256	28	-4.5	0.000
stalk diameter (mm)	2003	PHAKC	PH2VK	15	15	11.1	13.2	-2.1	1.870	1.971	0.483	0.509	28	-3.0	0.005

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Exhibit B. Novelty Statement Tables

Table 1B: Summary data from Johnston and Dallas Center, IA across years and environments are supporting evidence for differences between PHAKC and PH2VK. Environments had different planting dates and were in different fields. A two-sample t-test was used to compare differences between means.

Datafield	VARIETY-1	VARIETY-2	Count-1	Count-2	Mean-1	Mean-2	Mean_Diff	StdDeviation-1	StdDeviation-2	StdError-1	StdError-2	DF_Pooled	t-Value_Pooled	Prob_(2-tail)_Pooled
husk length (cm)	PHAKC	PH2VK	30	30	24.7	22.4	2.3	1.579	1.163	0.288	0.212	58	6.4	0.000
stalk diameter (mm)	PHAKC	PH2VK	30	30	12.1	14.4	-2.3	2.090	1.938	0.382	0.354	58	-4.4	0.000

Table 2A: Data from the area of adaptation of PHAKC broken out by year and across environments are supporting evidence for differences between PHAKC and PH2VK. Each year varieties were grown in different locations that had different environmental conditions. Environments had different planting dates and were in different fields. A two-sample t-test was used to compare differences between means.

Datafield	EXPT_YEAR	GE Name1	GE Name2	Mean1	Mean2	#Locs	Diff	SD1	SD2	Tvalue	Prob
GLFSPT score ABS	2001	PHAKC	PH2VK	4.5	5.8	4	-1.3	0.6	0.9	-3.87	0.0305
GLFSPT score ABS	2002	PHAKC	PH2VK	3.7	4.8	3	-1.2	0.3	0.3	-7	0.0198
GLFSPT score ABS	2003	PHAKC	PH2VK	4.1	5.8	5	-1.7	0.7	0.9	-3.16	0.0343

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Exhibit B. Novelty Statement Tables

Table 2B: Summary data from the area of adaptation of PHAKC across years and environments are supporting evidence for differences between PHAKC and PH2VK. Environments had different planting dates and were in different fields. A two-sample t-test was used to compare differences between means.

Datafield	GE Name1	GE Name2	Mean1	Mean2	#Locs	Dif	SD1	SD2	Tvalue	Prob
GLFSPT score ABS	PHAKC	PH2VK	4.1	5.5	12	-1.4	0.6	0.8	-5.78	0.0001

We are submitting lab SSR molecular marker data to further support our case for distinction. By looking at SSR marker data we can distinguish differences in genotype. Scoring of marker genotype is based on the size of the amplified fragment, which may be measured by the number of base pairs of the fragment. While variation in the primer used or in laboratory procedures can affect the reported number of base pairs, relative values should remain constant regardless of the specific primer or laboratory used. When comparing lines it is preferable if all SSR profiles are performed in the same lab. The SSR analyses reported herein were conducted in-house at Pioneer Hi-Bred.

A standard set of SSR markers were used to genetically profile the inbred PHAKC and its most similar variety PH2VK. The genetic profile data showed that for PHAKC, a large segment of the genome on chromosome 5 was inherited due to recombination from a variety other than the most similar variety PH2VK. This shows that these inbreds are genetically distinct and homozygous for this segment. The segment was over 210 cM long on the published IBM2 2004 Neighbors Fram map (Figure 1). This segment contains at least 16 publicly listed genes indicating that this chromosome segment is of functional significance. However, this segment undoubtedly contains many other genes, as the maize genome has recently been reported to contain over 59,000 functional genes (http://www.eurekalert.org/pub_releases/2004-10/rtsu-rro101204.php). The total map distance for the IBM2 2004 Neighbors Frame map is 7444 cM. If maize genes were randomly distributed, this would result in approximately 8 genes per cM, and 1680 genes in this 210 cM segment. Composite public physical maps can be found at (<http://www.maizegdb.org/>). The public polymorphic markers that define this distinct segment are listed (Table 3).

Table 3. SSR Marker scores for PHAKC and PH2VK on chromosome 5

SSR Marker	Chromosome Number	Position IBM2 Neighbors Map	PHAKC Base Pairs	PH2VK Base Pairs
UMC1240	5	-0.01	207.1	213.5
UMC1365	5	124.69	118	128
UMC1587	5	156.9	146.0	158.4
UMC1686	5	210.3	96.7	93.8

Chromosome 5 comparison of PHAKC with PH2VK

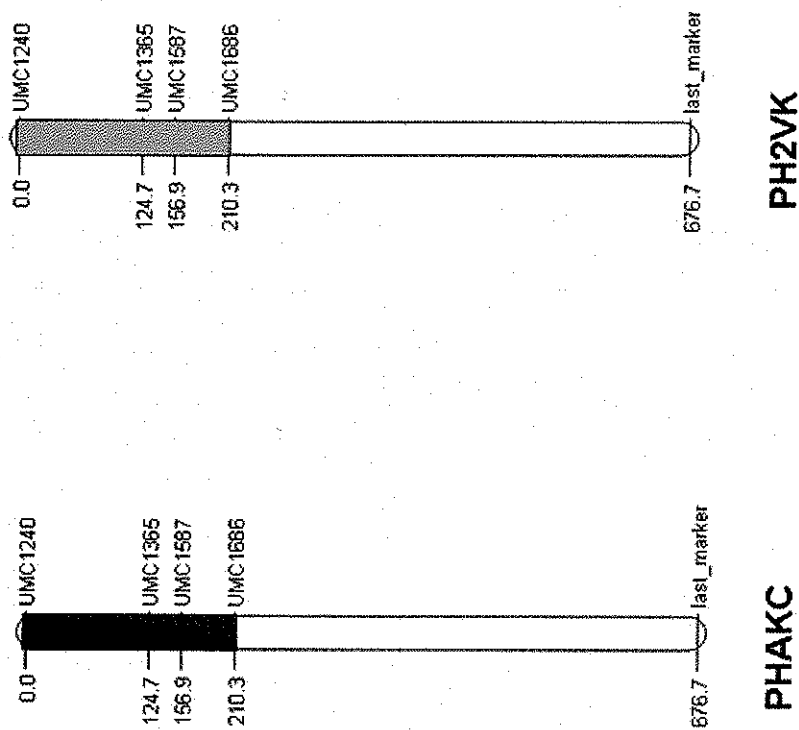


Figure 1. A polymorphic recombination segment on chromosome 5 shows a clear genetic difference between PHAKC and the most similar line PH2VK.

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Answers to PVP QA questions for accepting DNA fingerprinting differences:

1. The experimental design or procedures followed are published and cited;

Primers used for the SSRs reported are publicly available and may be found in the Maize GDB using the World Wide Web prefix followed by maizegdb.org (maintained by the USDA Agricultural Research Service), in Sharopova et al. (Plant Mol. Biol. 48(5-6):463-481), Lee et al. (Plant Mol. Biol. 48(5-6); 453-461), (<http://www.maizegdb.org/>).

The primers for these specific markers are listed:

UMC1240 <http://www.maizegdb.org/cgi-bin/displaylocusrecord.cgi?id=242236>

UMC1365 <http://www.maizegdb.org/cgi-bin/displaylocusrecord.cgi?id=248693>

UMC1587 <http://www.maizegdb.org/cgi-bin/displaylocusrecord.cgi?id=273181>

UMC1686 <http://www.maizegdb.org/cgi-bin/displaylocusrecord.cgi?id=292404>

2. The experimental design or procedures (or portions there of) can not be confidential;

The Peer reviewed methodology for SSR loci as molecular markers is cited below from this publication:

Smith et al (1997) An evaluation of the utility of SSR loci as molecular markers in maize (*Zea mays* L.): comparisons with data from RFLPs and pedigree. Theor Appl Genet 95: 163-173

3. The specific differentiating bands are cited;

Please refer to Table 3 and Figure 1

4. Photographic copies [of gels or other results] of scientific publishable quality with sufficient resolution and labeling to resolve the individual bands in question are provided;

We have included an example of the differentiating bands from the electropherogram for marker UMC1587 (Figure 2).

5. The procedure is well established and currently acceptable, or if novel, the results are from at least two independent laboratories with the experimental design appearing reliable.

See 1 and 2 above.

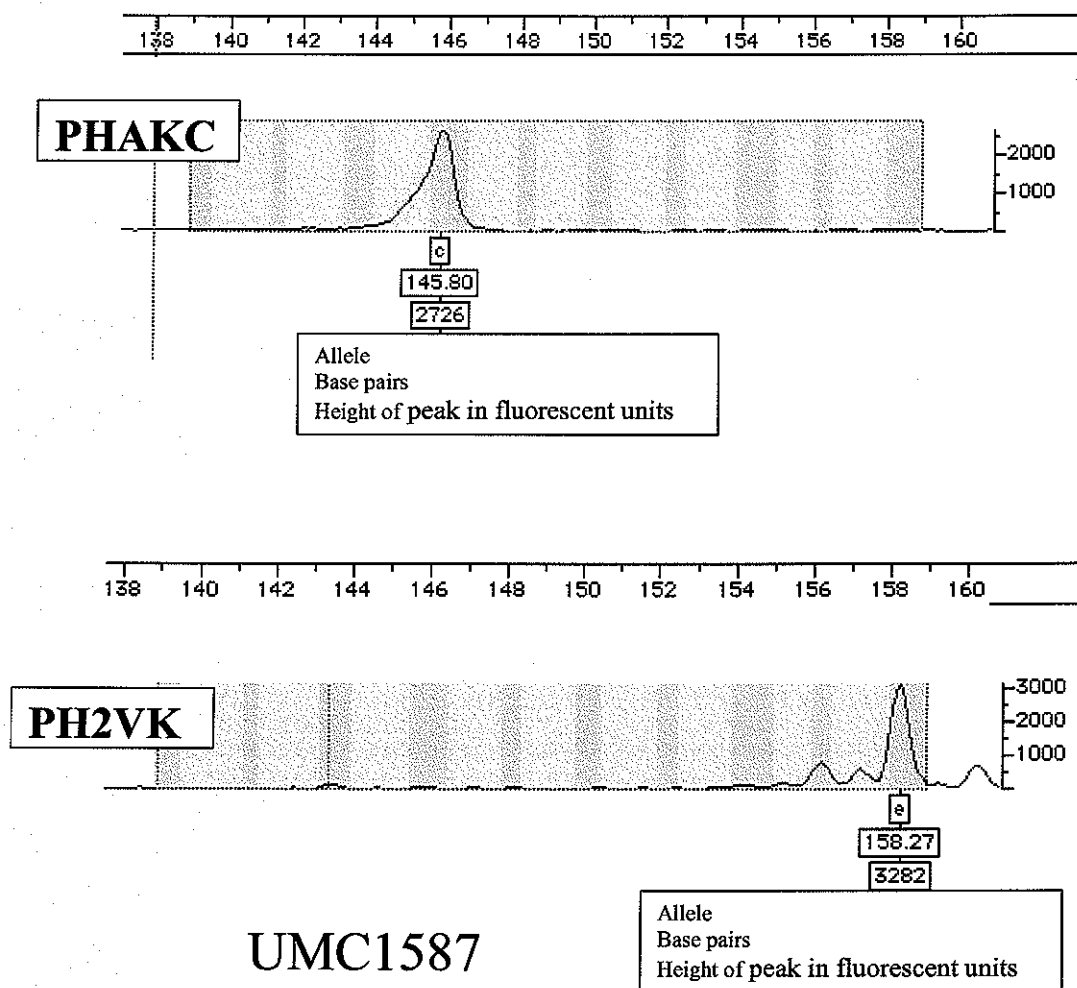


Figure 2. Electropherogram data for marker UMC1587

United States Department of Agriculture, Agricultural Marketing Service
Science and Technology, Plant Variety Protection Office
National Agricultural Library Building, Room 400
Beltsville, MD 20705-2351

OBJECTIVE DESCRIPTION OF VARIETY
CORN (Zea Mays L.)

Name of Applicant(s) Pioneer Hi-Bred International, Inc	Variety Seed Source	Variety Name or Temporary Designation PHAKC
Address (Street & No., or R.F.D. No., City, State, Zip Code and Country) 7301 NW 62nd Avenue, P.O. Box 85, Johnston, Iowa 50131-0085	FOR OFFICIAL USE	PVPO Number 200400199

Place the appropriate number that describes the varietal characters typical of this inbred variety in the spaces below. Right justify whole numbers by adding leading zeroes if necessary. Completeness should be striven for to establish an adequate variety description. Traits designated by a "*" are considered necessary for an adequate variety description and must be completed.

COLOR CHOICES (Use in conjunction with Munsell color code to describe all color choices; describe #25 and #26 in Comments section):

01. Light Green	06. Pale Yellow	11. Pink	16. Pale Purple	21. Buff	26. Other (Describe)
02. Medium Green	07. Yellow	12. Light Red	17. Purple	22. Tan	
03. Dark Green	08. Yellow-Orange	13. Cherry Red	18. Colorless	23. Brown	
04. Very Dark Green	09. Salmon	14. Red	19. White	24. Bronze	
05. Green-Yellow	10. Pink-Orange	15. Red & White	20. White Capped	25. Variegated (Describe)	

STANDARD INBRED CHOICES [Use the most similar (in background and maturity) of these to make comparisons based on grow-out trial data]:

Yellow Dent Families:		Yellow Dent (Unrelated):	Sweet Corn:
Family	Members	Co109, ND246	C13, Iowa5125, P39, 2132
B14	CM105, A632, B64, B68	Oh7, T232	
B37	B37, B76, H84	W117, W153R	Popcorn:
B73	N192, A679, B73, Nc268	W182BN	SG1533, 4722, HP301, HP7211
C103	Mo17, Va102, Va35, A682		
Oh43	A619, MS71, H99, Va26	White Dent:	Pipecorn:
WF9	W64A, A554, A654, Pa91	Cl66, H105, Ky228	Mo15W, Mo16W, Mo24W

1. TYPE: (describe intermediate types in comments section) 3 (1=Sweet, 2=Dent, 3=Flint, 4=Flour, 5=Pop, 6=Ornamental, 7=Pipecorn) Flint-dent Comments: Flint/Dent	Standard Inbred Name 2 Type	B73
2. REGION WHERE DEVELOPED IN THE U.S.A.: 2 (1=N.West, 2=N.Central, 3=N.East, 4=S.East, 5=S.Central, 6=S.West, 7=Other)	Standard Seed Source _ Region	PI 550473
3. MATURITY (In Region Best Adaptability; show Heat Unit formula in "Comments" section):	DAYS	HEAT UNITS
DAYS HEAT UNITS		
62 1,451.0 From emergence to 50% of plants in silk	61	1,419.0
62 1,465.0 From emergence to 50% of plants in pollen	59	1,389.0
2 39 From 10% to 90% pollen shed	2	54
From 50% silk to optimum edible quality	---	---
From 50% silk to harvest at 25% moisture	---	---
4. PLANT:	St.Dev.	Sample Size
248.9 cm Plant Height (to tassel tip)	16.10	30
89.6 cm Ear Height (to base of top ear node)	13.27	30
17.7 cm Length of Top Ear Internode	2.43	30
0.0 Average Number of Tillers	0.01	6
1.2 Average Number of Ears per Stalk	0.18	6
2 Anthocyanin of Brace Roots: 1=Absent, 2=Faint, 3=Moderate, 4=Dark		2
Mean	St.Dev.	Sample Size
229.0	15.36	30
92.0	10.97	30
15.9	1.61	30
0.0	0.02	6
1.0	0.06	6

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5. LEAF			St.Dev.	Sample Size	Mean	St.Dev.	Sample Size
9.5	cm Width of Ear Node Leaf		1.43	30	8.9	1.17	30
81.5	cm Length of Ear Node Leaf		3.95	30	81.8	3.12	30
6.5	Number of leaves above top ear		0.63	30	6.3	0.94	30
21.2	Degrees Leaf Angle		4.99	30	19.6	6.04	30
(Measure from 2nd leaf above ear at anthesis to stalk above leaf)							
4	Leaf Color (Munsell code)	5GY 3/4			4	(Munsell code)	7.5GY 3/4
4	Leaf Sheath Pubescence (Rate on scale from 1=none to 9=like peach fuzz)				2		
	Marginal Waves (Rate on scale from 1=none to 9=many)						
	Longitudinal Creases (Rate on scale from 1=none to 9=many)						
6. TASSEL:			St.Dev.	Sample Size	Mean	St.Dev.	Sample Size
4.1	Number of Primary Lateral Branches		1.31	30	6.8	1.42	30
47.2	Branch Angle from Central Spike		16.45	30	13.5	7.48	30
59.2	cm tassel Length		3.06	30	57.2	4.31	30
(from top leaf collar to tassel tip)							
4	Pollen Shed (Rate on scale from 0=male sterile to 9=heavy shed)				5		
14	Anther Color (Munsell code)	2.5R 3/8			7	(Munsell code)	5Y 8.5/4
2	Glume Color (Munsell code)	5GY 5/6			2	(Munsell code)	5GY 5/6
1	Bar Glumes (Glume Bands): 1=Absent, 2=Present				1		
7a. EAR (Unhusked Data):							
1	Silk Color (3 days after emergence) (Munsell code)	5GY 9/4			1	Munsell code	2.5GY 9/4
2	Fresh Husk Color (25 days after 50% silking) (Munsell code)	5GY 6/8			2	Munsell code	5GY 7/8
19	Dry Husk Color (65 days after 50% silking) (Munsell code)	5Y 9/2			21	Munsell code	2.5Y 8.5/4
2	Position of Ear at Dry Husk Stage: 1=Upright, 2=Horizontal, 3=Pendent				3		
6	Husk Tightness (Rate on scale from 1=very loose to 9=very tight)				7		
2	Hush Extension (at harvest): 1=Short(ears exposed), 2=Medium (<8cm), 3=Long (8-10cm beyond ear tip), 4=Very Long (>10cm)				3		
7b. EAR (Husked Ear Data)			St. Dev.	Sample Size	Mean	St.Dev.	Sample Size
15.2	cm Ear Length		1.41	30	13.1	1.33	30
43.0	mm Ear Diameter at mid-point		2.15	30	43.7	2.97	30
113.9	gm Ear Weight		23.59	30	95.2	29.29	30
14.5	Number of Kernel Rows		1.04	30	17.8	1.42	30
2	Kernel Rows: 1=Indistinct, 2=Distinct				2		
2	Row Alignment: 1=Straight, 2=Slightly Curved, 3=Spiral				2		
12.2	cm Shank Length		2.85	30	7.6	3.15	30
2	Ear Taper: 1=Slight, 2=Average, 3=Extreme				2		
8. KERNEL (Dried):			St.Dev.	Sample Size	Mean	St.Dev.	Sample Size
11.1	mm Kernel Length		0.91	30	10.2	1.02	30
7.9	mm Kernel Width		0.63	30	6.6	0.72	30
5.1	mm Kernel Thickness		0.71	30	4.0	0.45	30
48.7	% Round Kernels (Shape Grade)		16.29	5	11.2	7.51	5
1	Aleurone Color Pattern: 1=Homozygous, 2=Segregating (Describe)				1		
8	Aleurone Color (Munsell code)	7.5YR 7/16			7	Munsell code	2.5Y 8/12
8	Hard Endosperm Color (Munsell code)	7.5YR 7/14			7	Munsell code	10YR 7/12
3	Endosperm Type: 1=Sweet(su1), 2=Extra Sweet(sh2), 3=Normal Starch, 4=High Amylose Starch, 5=Waxy Starch, 6=High Protein, 7=High Lysine, 8=Super Sweet (se), 9=High Oil, 10=Other				3		
26.5	gm Weight per 100 kernels (unsized sample)		4.68	6	17.2	5.31	6

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Note: Use chart on first page to choose color codes for color traits

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9. COB:	St.Dev.	Sample Size	Mean	St.Dev.	Sample Size
<u>25.3</u> mm Cob Diameter at mid-point	<u>0.92</u>	<u>30</u>	<u>28.8</u>	<u>1.35</u>	<u>30</u>
<u>14</u> Cob Color (Munsell code)	<u>10R 3/8</u>		<u>11</u> Munsell code	<u>10R 6/6</u>	

10. DISEASE RESISTANCE (Rate from 1 (most susceptible) to 9 (most resistant); leave blank if not tested; leave Race or Strain Options blank if polygenic):

A. Leaf Blights, Wilts, and Local Infection Diseases

- ☐ Anthracnose Leaf Blight (*Colletotrichum graminicola*)
- ☐ Common Rust (*Puccinia sorghi*)
- ☐ Common Smut (*Ustilago maydis*)
- ☐ Eyespot (*Kabatiella zeae*)
- ☐ Goss's Wilt (*Clavibacter michiganense* spp. *nebraskense*)
- 4 Gray Leaf Spot (*Cercospora zeae-maydis*)
- ☐ Helminthosporium Leaf Spot (*Bipolaris zeicola*) Race _____
- 5 Northern Leaf Blight (*Exserohilum turcicum*) Race _____
- ☐ Southern Leaf Blight (*Bipolaris maydis*) Race _____
- 4 Southern Rust (*Puccinia Polysora*)
- ☐ Stewart's Wilt (*Erwinia stevartii*)
- ☐ Other (Specify) _____

B. Systemic Diseases

- ☐ Corn Lethal Necrosis (MCMV and MDMV)
- 9 Head Smut (*Sphacelotheca reiliana*)
- ☐ Maize Chlorotic Dwarf Virus (MCDV)
- ☐ Maize Chlorotic Mottle Virus (MCMV)
- 5 Maize Dwarf Mosaic Virus (MDMV) Strain _____
- ☐ Sorghum Downy Mildew of Corn (*Peronosclerospora sorghi*)
- ☐ Other (Specify) _____

C. Stalk Rots

- 5 Anthracnose Stalk Rot (*Colletotrichum graminicola*)
- ☐ Diplodia Stalk Rot (*Stenocarpella maydis*)
- ☐ Fusarium Stalk Rot (*Fusarium moniliforme*)
- ☐ Gibberella Stalk Rot (*Gibberella zeae*)
- ☐ Other (Specify) _____

D. Ear and Kernel Rots

- ☐ Aspergillus Ear and Kernel Rot (*Aspergillus flavus*)
- 5 Diplodia Ear Rot (*Stenocarpella maydis*)
- 5 Fusarium Ear and Kernel Rot (*Fusarium moniliforme*)
- 6 Gibberella Ear Rot (*Gibberella zeae*)
- ☐ Other (Specify) _____

- ☐ Anthracnose Leaf Blight
- ☐ Common Rust
- ☐ Common Smut
- ☐ Eyespot
- ☐ Goss's Wilt
- 3 Gray Leaf Spot
- ☐ Helminthosporium Leaf Spot Race _____
- 3 Northern Leaf Blight Race _____
- ☐ Southern Leaf Blight Race _____
- 4 Southern Rust
- ☐ Stewart's Wilt
- ☐ Other (Specify) _____

- ☐ Corn Lethal Necrosis
- 9 Head Smut
- ☐ Maize Chlorotic Dwarf Virus
- ☐ Maize Chlorotic Mottle Virus
- 6 Maize Dwarf Mosaic Virus Strain _____
- ☐ Sorghum Downy Mildew of Corn
- ☐ Other (Specify) _____

- 4 Anthracnose Stalk Rot
- ☐ Diplodia Stalk Rot
- ☐ Fusarium Stalk Rot
- ☐ Gibberella Stalk Rot
- ☐ Other (Specify) _____

- ☐ Aspergillus Ear & Kernel Rot
- 2 Diplodia Ear Rot
- 5 Fusarium Ear & Kernel Rot
- 4 Gibberella Ear Rot
- ☐ Other (Specify) _____

Application Variety Data

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I Standard Inbred Data

Note: Use chart on first page to choose color codes for color traits.

11. INSECT RESISTANCE (Rate from 1 (most susceptible) to 9 (most resistant); Leave blank if not tested)	St. Dev.	Sample Size		St. Dev.	Sample Size
<input type="checkbox"/> Banks Grass Mite (<i>Oligonychus pratensis</i>)				<input type="checkbox"/> Banks Grass Mite	
Corn Earworm (<i>Helioverpa zea</i>)				Corn Earworm	
<input type="checkbox"/> Leaf Feeding				<input type="checkbox"/> Leaf Feeding	
<input type="checkbox"/> Silk Feeding _____ mg larval wt.				<input type="checkbox"/> Ear Damage	
<input type="checkbox"/> Ear Damage				<input type="checkbox"/> Corn Leaf Aphid	
<input type="checkbox"/> Corn Leaf Aphid (<i>Rhopalosiphum maidis</i>)				<input type="checkbox"/> Corn Sap Beetle	
<input type="checkbox"/> Corn Sap Beetle (<i>Carpophilus dimidiatus</i>)				European Corn Borer	
European Corn Borer (<i>Ostrinia nubilalis</i>)				<input type="checkbox"/> 1 st Generation	
<input type="checkbox"/> 1 st Generation (Typically Whorl Leaf Feeding)				<input type="checkbox"/> 2 nd Generation	
<input type="checkbox"/> 2 nd Generation (Typically Leaf Sheath-Collar Feeding)					
<input type="checkbox"/> Stalk Tunneling: _____ cm tunneled/plant				Fall Armyworm	
Fall Armyworm (<i>Spodoptera frugiperda</i>)				<input type="checkbox"/> Leaf-Feeding	
<input type="checkbox"/> Leaf-Feeding				<input type="checkbox"/> Maize Weevil	
<input type="checkbox"/> Silk-Feeding _____ mg larval wt.					
<input type="checkbox"/> Maize Weevil (<i>Sitophilus Zeamaize</i>)				<input type="checkbox"/> Northern Rootworm	
<input type="checkbox"/> Northern Rootworm (<i>Diabrotica barberi</i>)				<input type="checkbox"/> Southern Rootworm	
<input type="checkbox"/> Southern Rootworm (<i>Diabrotica undecimpunctata</i>)				Southwestern Corn Borer	
Southwestern Corn Borer (<i>Diatraea grandiosella</i>)				<input type="checkbox"/> Leaf Feeding	
<input type="checkbox"/> Leaf Feeding					
<input type="checkbox"/> Stalk Tunneling: _____ cm tunneled/plant				<input type="checkbox"/> Two-spotted Spider Mite	
<input type="checkbox"/> Two-spotted Spider Mite (<i>Tetranychus urticae</i>)				<input type="checkbox"/> Western Rootworm	
<input type="checkbox"/> Western Rootworm (<i>Diabrotica virgifera virgifera</i>)				<input type="checkbox"/> Other (Specify) _____	
<input type="checkbox"/> Other (Specify) _____					
12. AGRONOMIC TRAITS:					
<input checked="" type="checkbox"/> Stay Green (at 65 days after anthesis) (Rate on scale from 1=worst to 9=excellent)				<input checked="" type="checkbox"/> Stay Green	
<input type="checkbox"/> % Dropped Ears (at 65 days after anthesis)				<input type="checkbox"/> % Dropped Ears	
<input type="checkbox"/> % Pre-anthesis Brittle Snapping				<input type="checkbox"/> % Pre-anthesis Brittle Snapping	
<input type="checkbox"/> % Pre-anthesis Root Lodging				<input type="checkbox"/> % Pre-anthesis Root Lodging	
<input checked="" type="checkbox"/> Post-anthesis Root Lodging				<input checked="" type="checkbox"/> Post-anthesis Root Lodging	
<u>6,062.0</u> kg/ha Yield of Inbred per se (at 12-13% grain moisture)				<u>5,832.0</u> Yield	
13. MOLECULAR MARKERS: (0=data unavailable; 1=data available but not supplied; 2=data supplied.)					
<input checked="" type="checkbox"/> Isozymes	<input type="checkbox"/> RFLP's	<input type="checkbox"/> RAPD's	<input type="checkbox"/> Other (Specify) _____		

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- Stringfield, G.H. Maize Inbred Lines of Ohio A.E.S., Bul. 831. 1959.
- U.S. Department of Agriculture 1936, 1937. Yearbook.

COMMENTS (e. g. state how heat units were calculated, standard inbred seed source, and/or where data was collected. Continue in Exhibit D)

Insect, disease, brittle snapping and root lodging data are collected mainly from environment where variability for the trait can be obtained within the experiment.

Our experimental design was set up in a typical complete block design commonly used in agricultural corn research experiments using three locations/environments. One replication was grown at each location. This is one more environment than is required according to the PVP application instructions. Our approach was to test the variety in more than 1 location (as instructed) while also allowing us the extra location/environment if there should be an unexpected failure at a location due to weather or other problems. There may also be situations where an additional year of testing was conducted resulting in 2 years of trial data. There would likely be more variability due to soil type differences, nutrients, or weather typical of different testing environments than if all three trials were grown in the same field on the same farm with the same planting dates in the same year. If you recommend that all locations/environments are grown in the same field with the same planting dates and same year, please let us know and we will adjust our 2007 procedures.

The experimental design and methods for 2003 were as follows:

Please update the exhibit C addendum with this paragraph:

The experiment procedures involved three environments with different planting dates, planted in 17.42 ft. rows with 2 rows for each variety. Approximately 24-30 plants emerged in each of 2 rows for a total of around 48 to 60 plants being evaluated at each location and 144 to 180 plants across locations. For plant level traits, we sampled 5 representative plants from the 2 rows of the 2 row plot (group) of plants at each location. For plot level traits we evaluated the 2 row plot (group) and gave a representative score or average on the 48-60 plants in the group within an experiment.

Some traits can be especially variable under different environmental factors influenced by weather, soil type, or planting dates. Varying temperatures or day length could impact the meristem growth during various tissue differentiation stages. The meristem differentiation of the ear and other tissues could be impacted as well as the success of pollination during flowering and frequency of kernel abortion during grain fill. Such variation could impact some of the traits that you mention because our experiment design does not grow all of the trials in the same field with the same planting date.

I would be happy to share detailed protocols or discuss with you in more detail the sampling, experiment design, reporting, and the conscientious evaluations that went into the characterization of the data..

Please note the data presented in Exhibit B and C, "Objective Description of Variety," are collected primarily at Johnston and Dallas Center, Iowa. The data in Tables 1A and 1B are from two sample t-tests using data collected in Johnston and Dallas Center, IA. These traits in exhibit B collectively show distinct differences between the two varieties.

U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE

Application is required in order to determine if a plant variety protection certificate is to be issued (7 U.S.C. 2421). The information is held confidential until the certificate is issued (7 U.S.C. 2426).

EXHIBIT E
STATEMENT OF THE BASIS OF OWNERSHIP

1. NAME OF APPLICANT(S) PIONEER HI-BRED INTERNATIONAL, INC.	2. TEMPORARY DESIGNATION OR EXPERIMENTAL NUMBER	3. VARIETY NAME PHAKC
4. ADDRESS (Street and No., or R.F.D. No., City, State, and ZIP, and Country) 7301 NW 62nd AVENUE P.O. BOX 85 JOHNSTON, IA 50131-0085	5. TELEPHONE (include area code) 515-270-4051 7. PVPO NUMBER 2004 00 199	6. FAX (include area code) 515-253-2125

8. Does the applicant own all rights to the variety? Mark an "X" in the appropriate block. If no, please explain: ☒ YES ☐ NO9. Is the applicant (individual or company) a U.S. national or a U.S. based company? If no, give name of country ☒ YES ☐ NO10. Is the applicant the original owner? ☒ YES ☐ NO If no, please answer one of the following:

a. If the original rights to variety were owned by individual(s), is (are) the original owner(s) a U.S. National(s)?

☐ YES ☐ NO If no, give name of country

b. If the original rights to variety were owned by a company(ies), is (are) the original owner(s) a U.S. based company?

☒ YES ☐ NO If no, give name of country

11. Additional explanation on ownership (Trace ownership from original breeder to current owner. Use the reverse for extra space if needed):

Pioneer Hi-Bred International, Inc. (PHI), Des Moines, Iowa, and/or its wholly owned subsidiary Pioneer Overseas Corporation (POC), Des Moines, Iowa, is the employer of the plant breeders involved in the selection and development of PHAKC. Pioneer Hi-Bred International and/or Pioneer Overseas Corporation has the sole rights and ownership of PHAKC pursuant to written contracts that assign all rights in the variety to PHI and/or POC at the time such variety was created. No rights to this variety are retained by any individuals.

PLEASE NOTE:

Plant variety protection can only be afforded to the owners (not licensees) who meet the following criteria:

1. If the rights to the variety are owned by the original breeder, that person must be a U.S. national, national of a UPOV member country, or national of a country which affords similar protection to nationals of the U.S. for the same genus and species.
2. If the rights to the variety are owned by the company which employed the original breeder(s), the company must be U.S. based, owned by nationals of a UPOV member country, or owned by nationals of a country which affords similar protection to nationals of the U.S. for the same genus and species.
3. If the applicant is an owner who is not the original owner, both the original owner and the applicant must meet one of the above criteria.

The original breeder/owner may be the individual or company who directed the final breeding. See Section 41(a)(2) of the Plant Variety Protection Act for definitions.

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0581-0055. The time required to complete this information collection is estimated to average 0.1 hour per response, including the time for reviewing the instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

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